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5.2 Derivation of a 3D volume in highly distorted ICF implosions from multiple line-of-sight imaging

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Estimating the volume of a highly distorted ICF core is critical to evaluating the performance of an ICF implosion: degree of alpha heating is inferred from hot spot pressure, which is in turn derived from hot spot volume, as observed from x-ray self-emission images. Accurate tomographic reconstruction to determine volume is precluded by the limited number of accessible lines of sight (typically two). Moreover, due to dynamically evolving temperature and density gradients, hot spot boundaries are difficult to define and thus to observe. Approximations using spherical or elliptical assumptions have been shown to over-predict the volume significantly. We describe a method to infer volumes of asymmetric shapes using orthogonal images and emission intensity with no assumption of symmetry or critical contour. An ensemble of simulated images was used to validate the method, and application of the technique to recent NIF implosions has revealed trends in time-dependent volume that provide insights into stagnation dynamics. This work also provides a tool for quantifying the amount of material that jets into the hot spot via engineering features -- a leading hypothesis for the underperformance of ICF implosions. Prepared by LLNL under Contract DE-AC52-07NA27344, LLNL-ABS-744386.

Primary author(s) : BENEDETTI , Laura Robin (LLNL)

Co-author(s) : NAGEL , S. R. (LLNL); MA , T. (LLNL); KHAN, S. F. (LLNL); PAK, A. (LLNL); IZUMI, N. (LLNL)

Presenter(s) : BENEDETTI , Laura Robin (LLNL); NAGEL , S. R. (LLNL); MA , T. (LLNL); KHAN, S. F. (LLNL); PAK, A. (LLNL); IZUMI, N. (LLNL)

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